CBCS SCHEME

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15AE553

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Theory of Vibrations

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Any missing data may be suitably assumed.

Module-1

1 a. List the different types of vibrations. Discuss any two types with suitable examples. **(08 Marks)**

b. Represent the periodic motion given in the Fig.Q1(b) by harmonic series. **(08 Marks)**

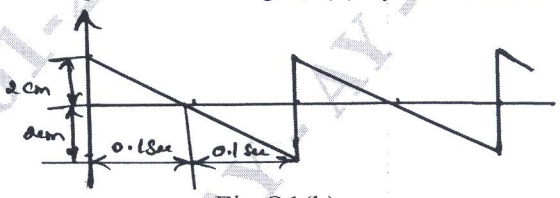

Fig.Q1(b)

OR

2 a. Define vibration. List the root causes of vibrations and different methods of eliminating undesirable vibrations. **(04 Marks)**

b. The motion of a particle is x = 5 sin wt. Show the relative position and magnitudes of the displacements velocity and acceleration vector at time t = 0 when (i) w = 0.5 rad/sec (ii) w = 2 rad/sec. **(06 Marks)**

c. A harmonic motion is given by the equation $n(t) = 5 \sin(15t - \pi/4)$ cm where phase angle is in radians and t in seconds. Find
(i) Period of motion (ii) Frequency (iii) Maximum displacement, velocity and acceleration. **(06 Marks)**

Module-2

3 a. Define undamped free vibration. Derive an expression for equation of motion and natural frequency of vibration of a spring mass system in vertical position using Newton's method. **(08 Marks)**

b. A flywheel is mounted on a vertical shaft as shown in Fig.Q3(b). Both ends of shaft are fixed and diameter is 50mm. The flywheel has a mass of 500 kg and radius of gyration 0.5m find natural frequency of (i) longitudinal vibration (ii) Transverse vibration (iii) Torsional vibrations.
Take E = 200 GN/m^2, G = 84 GN/m^2, d = 50 mm, m = 500 kg, k = 0.5m **(08 Marks)**

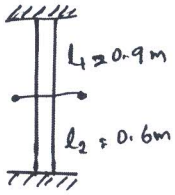

Fig.Q3(b)

OR

4 a. Define Logarithmic Decrement. Derive an expression for the same with usual notation. **(08 Marks)**

b. A mass of 2 kg is supported as an isolator having a spring scale of 2940 N/m and viscous damping. If the amplitude of tree vibration of the mass falls to one half of its original value in 1.5 seconds, determine the damping coefficient of the isolator. **(08 Marks)**

Module-3

5 a. Derive an expression for forced vibrations of undamped single degree system. **(08 Marks)**

b. Explain forced vibration of a single degree of freedom system in detail. List the reasons for unbalancing in a system. **(08 Marks)**

OR

6 a. Define whirling speed and derive an expression for whirling of shafts without air damping. **(08 Marks)**

b. A vibrometer gives a reading of relative displacement of 0.5 mm. The natural frequency of vibration is 600 rpm and the machine runs at 200 rpm. Determine the magnitude of displacement, velocity and acceleration of the vibrating machine pot. **(08 Marks)**

Module-4

7 a. With help of suitable sketches illustrate the working of the following :
(i) Dynamic Vibration Absorber (ii) Dynamics of reciprocating engines. **(10 Marks)**

b. Describe the principle modes and normal modes of vibration. **(06 Marks)**

OR

8 a. Derive an expression for the free longitudinal vibration of a uniform bar of length L, one end of which is fixed and the other end free. **(08 Marks)**

b. Find the frequency and normal modes of transverse vibration of a simply supported beam of length L. **(08 Marks)**

Module-5

9 Using Stodola's method determine the fundamental mode of vibration and its natural frequency of the spring mass system shown in Fig.Q9. **(16 Marks)**

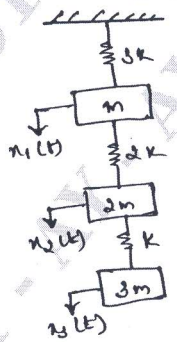

Fig.Q9

OR

10 Determine the natural frequency and the mode shapes of the system shown in Fig.Q10 by Holzer's method. **(16 Marks)**

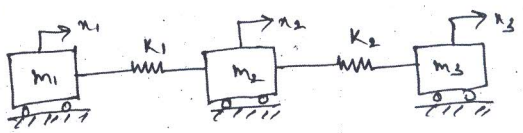

Fig.Q10

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